Corresponds to AT291003B

PATENT SPECIFICATION

(11) 1248873

1248873

DRAWINGS ATTACHED

(21) Application No. 19765/70 (22) Filed 24 April 1970
(31) Convention Application No. A4077 (32) Filed 28 April 1969 in
(33) Austria (OE)
(45) Complete Specification published 6 Oct. 1971
(51) International Classification F 04 d 15/00 9/02//29/22
(52) Index at acceptance
F1C 1B1A 2B3C 2J1X 2J2X 2S

(54) IMPROVEMENTS IN OR RELATING TO CENTRIFUGAL PUMPS

(71) I, PAUL BUNGARTZ, a citizen of the German Federal Republic, of Dusseldorfer Strasse 79, Dusseldorf-Oberkassel, Germany, do hereby declare the invention, for which I pray that a patent may be granted to me, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to a centrifugal pump which receives liquid from a container supplied with liquid at a varying rate.

When a container is supplied with liquid at a varying rate and the variation of the liquid level in the container is to be kept within close limits, centrifugal pumps receiving liquid from such containers had previously to be provided with regulating valves, such as float-controlled throttling valves. These regulating valves add to the costs and are liable to be deranged. Particularly great difficulties are involved in the regulation where boiling or gas-containing liquids are handled because a release of gas or formation of vapor at the leading edges of the impeller blades of the centrifugal pump will also influence the efficiency of the pump.

It is an object of the invention to eliminate these disadvantages and to provide a centrifugal pump the efficiency of which as automatically controlled in response to the rate at which liquid is received by the pump so that there is no need for separate regulating valves and which pump is also suitable to handle gas-containing or boiling liquids.

This object is substantially accomplished by the invention in that the inlet eye of the pump impeller is connected to a gas space of the supply container by ducts which extend through the impeller backplate to the rear of the impeller backplate, an annular clearance surrounding the driving shaft, an annular chamber adjoining said annular clearance, and a conduit connected to said annular chamber and to the gas space of the supply container, and blades are provided on the rear surface of the impeller backplate and serve to keep liquid from said annular clearance surrounding the shaft. As a result gas or air can circulate freely between the inlet eye of the pump impeller and the gas space of the supply container and the pressure in the inlet eye of the pump impeller will always be the same as the pressure in the gas space of the supply container. A rise of the liquid level in the supply container will cause gas to be displaced from the impeller chamber through the ducts and a ring of liquid corresponding to the discharge pressure of the pump will form in the impeller. Upon an increase of the rate at which liquid is received by the pump, the ring of liquid will be inwardly enlarged and the gas cushion in the impeller will be reduced in size. If the pump receives liquid at a lower rate, the gas cushion will be increased in size and the ring of liquid will be reduced in size. The blades provided on the rear of the impeller backplate serve to keep liquid from the clearance which surrounds the driving shaft even when the pump is operated at a maximum total head so that the circulation of gas will not be obstructed.

In a development of the invention, the said blades are subdivided into an inner stage and an outer stage and the ducts communicate directly with the inner stage, which is small in diameter and provided with wide blades. Just as in a centrifuge, a stable, wide ring of liquid is formed in the outer part of the inner stage so that any liquid-gas mixture which flows in through the ducts can well be separated and liquid will be reliably kept from the clearance which surrounds the shaft. In such arrangement, the outer stage serves to relieve the gap between the two stages from the discharge pressure.

In accordance with another feature of the invention, the ducts communicate with the inlet eye at the position of leading edges of the main impeller blades and these leading edges are inwardly inclined towards the impeller hub. With that design, the influence of a gas cushion which may form near the impeller hub on the flowing liquid will be minimized and

the gas will be entrained only at a low rate even when the pump operates with a low capacity.

The efficiency of a pump according to the invention will be controlled automatically in response to the liquid intake rate. The pump can handle also gas-containing or boiling liquids because gas or vapor from the cushions forming on the inlet side of the impeller will be forced through the ducts into the gas space of the supply container so that the efficiency of the pump will be automatically controlled also when such liquids are handled.

An embodiment of the invention is shown by way of example in a partly diagrammatic sectional view on the drawing.

An inlet eye a of a centrifugal pump impeller is connected to a gas space g of a supply container by ducts b, which extend through the impeller backplate, a clearance c surrounding the driving shaft, an annular chamber d adjoining the clearance c, and a conduit e extending from the annular chamber to the supply container. Blades are provided on the rear surface of the impeller blackplate and are sub-divided into an outer stage h and an inner stage i. The blades are of small radius and are wide at the inner stage i and function like a centrifuge which separates any liquid-gas mixture entering through the ducts b and keeps liquid reliably from the clearance c surrounding the shaft. The outer sealing stage h serves to relieve the gap k between the two stages from the discharge pressure. It is apparent that the ducts b communicate with the inlet eye a at the position of the leading edges of the main impeller blades and that the leading edges of the main impeller blades are inwardly inclined towards the impeller hub so that the influence of a gas cushion f which may form adjacent to the hub on the flowing liquid will be minimized and gas will be entrained by the impeller only at a low rate even when the pump is operated at a low capacity.

Owing to the communication between the inlet eye a and the gas cushion f, on the one hand, and the cushion f and the gas space g of the supply container, on the other hand, gas or air can circulate freely and the pressure in the inlet eye of the pump is always equal to the gas pressure in the supply container. Specifically, no subatmospheric pressure tending to suck in liquid can develop in the inlet eye.

WHAT I CLAIM IS:—

1. A centrifugal pump which receives liquid from a container supplied with liquid at a varying rate, the inlet eye of the pump impeller being connected to a gas space of the supply container by ducts which extend through the impeller backplate to the rear of the impeller backplate, an annular clearance surrounding the driving shaft, an annular chamber adjoining said annular clearance, and a conduit connected to said annular chamber and to the gas space of the supply container, and blades are provided on the rear surface of the impeller backplate and serve to keep liquid from said annular clearance surrounding the shaft.

2. A centrifugal pump as claimed in claim 1, in which the said blades are sub-divided into an inner stage and an outer stage and the ducts communicate directly with the inner stage, which is small in diameter and provided with wide blades.

3. A centrifugal pump as claimed in claim 1 or 2, in which the ducts communicate with the inlet eye at the portion of leading edges of the main impeller blades and these leading edges are inwardly inclined towards the impeller hub.

4. A centrifugal pump, substantially as described hereinbefore with reference to the accompanying drawing.

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Printed for Her Majesty's Stationery Office, by the Courier Press, Leamington Spa, 1971.
Published by The Patent Office, 25 Southampton Buildings, London, WC2A 1AY, from which copies may be obtained.

1248873 COMPLETE SPECIFICATION

1 SHEET *This drawing is a reproduction of the Original on a reduced scale*